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WINNEBAGO RIVER BRIDGE
Iowa Bridges Recording Project
Spanning over the Winnebago River on U.S. Highway 65, 0.5 miles N of Mason City
Mason City Vicinity
Cerro Gordo County
Iowa

HAER No. IA-78

BLACK & WHITE PHOTOGRAPHS

WRITTEN HISTORICAL & DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Department of the Interior
P.O. Box 37127
Washington, D.C. 20013-7127

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WINNEBAGO RIVER BRIDGE

HAER No. IA-78

Location:	Spanning the Winnebago River on U.S. Highway 65, 0.5 miles north of Mason City, Cerro Gordo County, Iowa USGS: Section 28, Township 97 North, Range 20 West
Date of Construction:	1926
Designers:	Iowa State Highway Commission
Builders:	William Henkel, Mason City, Iowa; Concrete Engineering Company
Fabricators:	None
Present Owner:	Iowa Department of Transportation
Present Use:	Highway bridge
Significance:	The Winnebago Bridge, the longest monolithic concrete girder in Iowa, is the most technologically significant of the state's numerous concrete cantilevered girder bridges designed by the Iowa State Highway Commission. It also marks the culmination of this type of construction by ISHC.
Historians:	Richard Vidutis, James Hippen
Project information:	This document was prepared as part of the Iowa Historic Bridges Recording Project performed during the summer of 1996 by the Historic American Engineering Record (HAER). The project was sponsored by the Iowa Department of Transportation (IDOT). Preliminary research on this bridge was performed by Clayton B. Fraser of Fraserdesign, Loveland, Colorado.

EVENTS SCHEDULE

1926 - in the spring ISHC engineers design a cantilever deck girder to replace the superstructure (120' truss) of the Winnebago River Bridge.

June 1926 - competitive bids for the Winnebago River Bridge and four others are solicited by the county.

July 15, 1926 - county receives 11 bids. Work on the five bridges is divided among Mason City contractors, C.A. Holvik and William Henkel. William Henkel is awarded the construction contract for the Winnebago River Bridge superstructure and two others for a total of $21,920. Concrete Engineering Company is awarded the contract for work on the abutments.

1926 - apparently the Winnebago River Bridge is completed late in the year.

INTRODUCTION

When built in 1926, the Winnebago River Bridge was the longest monolithic concrete girder in Iowa. The 122′ long crossing used the cantilever principle of construction with the distance between piers being 70′. The previous old iron truss was removed and the original abutments were used for the new bridge. The use of the cantilever bridge by the Iowa Highway Commission was a design extension of its earlier use of simply supported concrete girder bridges standardized in 1914 and designated Standard Series H. It was three years later that the highway commission designed its first cantilevered deck girder for a three span structure over the Boyer River in Woodbine. The cantilevered design was chosen in part for its esthetics and for its functionality: it was considered more architecturally accomplished than a straight spandrel of simply supported girders, and it was "particularly well adapted for use on deep drainage ditches and streams subject to widening."[1] It also could carry more weight and span a greater distance than a simply supported girder of the same length. The Winnebago River Bridge marks the culmination of this kind of construction for the ISHC.[2]

I. REGIONAL HISTORY

Cerro Gordo County is located in the second tier of counties from the northern line of the State. The eastern portion is marked by numerous creeks and streams, and the rest of the county consists of prairies land and some swamps.[3] The third General Assembly, which convened at Iowa City on December 2, 1850, and adjourned February 5, 1851, spent a great deal of time on the creation of new counties. During that session about 50 counties were formed with Cerro Gordo being one of them.[4]

The first settlement in Cerro Gordo County occurred in Lime Creek Township by Joseph Hewitt and Jarvis Dickinson, both of whom came to the area to hunt in the summer of 1851. Summer rains caused such flooding that Hewitt and Dickinson were cut off from

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[1]Report of the State Highway Commission, 1917.

[2]Fraserdesign, Iowa Historic Bridge Inventory, Final Inventory Report, (1269 Loveland, Colorado, 1992), p. CERR01.

[3]History of Franklin and Cerro Gordo Counties, Iowa. (Springfield, Illinois: Union Publishing Co., 1863), p. 590.

[4]Ibid., p. 601.

returning to other settlements. They decided to stay the winter and eventually settled in the area. The first settlers to arrive in the area of Mason City were two brothers, David and Edwin Wright, who staked a claim 1852 on the banks of Lime Creek about three miles from present day Mason City. Others came to the region and by 1853 a town was laid out on the present site of Mason City. It was called Siboleth.[5]

Mason City is the county seat of Cerro Gordo and is situated at the junction of Lime and Willow Creeks. It was incorporated as a town in 1870, and in 1881 became a city. In the early years of its existence it was considered a city with many natural advantages such as timber, fine building stone, potter's clay, good water power, and surrounded by rich fertile soil, all of which enhanced its profitable retail trade. It was mainly settled by newcomers from the New England States and also attracted others who came to the resort environment of Clear Lake just nine miles away.[6]

By 1883 three railroad lines served Mason City giving it access to all points on the compass: the Dakota Branch of the Chicago, Milwaukee & St. Paul; the Central Railway of Iowa; and the Austin Branch of the Chicago, Milwaukee & St. Paul.[7] Finished by 1870, the railroads were most instrumental in increasing the wealth of the city as well as helping double its population. *The Dakota Branch* placed Mason City on a direct line to Milwaukee, to which large quantities of grain crops were transported, and farther points east. *The Central of Iowa* established a direct communication with St. Louis and St. Paul, without change of cars and was invaluable in giving the farming class a southern outlet via the numerous east west connections through Iowa; doing both a heavy passenger and freight business, it was considered to have done more for the development of Cerro Gordo than any other rail line. Prior to its construction there was no way to get coal for fuel, and the increasing scarcity of timber kept settlers away. With the line completed, large amounts of coal were shipped to Mason City from Iowa's southern coal fields. *The Austin Branch* formed a continuous line from St. Paul to Dubuque via Austin, Minnesota. Together with the Central of Iowa, a continuous line is formed from Duluth to St. Louis in the south considered to be

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[5]Ibid., pp. 593-4.

[6]Ibid., pp. 955-58.

[7]Ibid.

the great emporium of the south where Mason City could further its business interests.[8]

The railroads played an important role in shipping the local produce to markets outside of Mason City and even outside of Iowa. This was especially important for grain farmers who had access to Mason City and also became important to the area's growing lime and stone industries which assumed large proportions mainly due to the railroads exporting their products.[9] With the advent of motorized vehicles, the need for more and better roads increased, and in turn roads began to replace railroads to a great degree. Mason City today still a business hub in an agricultural region and is still at the crossroads of major roads traversing the state of Iowa: interstate U.S. 35, a few miles to the west of town, is a north-south route; state road 18 is a east-west road; and U.S. highway 65, which intersects state road 18, is a direct link south to Des Moines as well as north to interstate U.S. 90 in Minnesota. The Winnebago River Bridge (on U.S. 65) maintains a vital link within this network of state and interstate roads all of which are accessed by the region's rural county roads.

II. HISTORY OF THE WINNEBAGO RIVER BRIDGE

The Report of the state highway commission in 1926 states: "Design No. 426, Cerro Gordo County, is unique in being the longest monolithic concrete girder in the state. It is 122' long over all but makes use of the cantilever principle, the distance between piers being 70'."[10] The Winnebago River Bridge was built in 1926 at the location of a previous bridge which was a 120' truss. The instructions on the bridge designs instruct the engineers to remove and neatly pile the truss near the sight. The old stone abutments were to be saved and were reused for the new cantilevered deck girder bridge. The drawings were completed in the spring of 1926 by June, competitive bids were solicited for the Winnebago and four other bridges. On June 15, 1926, the county received eleven proposals. The Winnebago River Bridge

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[8]Ibid., pp. 970-72.

[9]Ibid., pp. 1004-5.

[10]Report of the State Highway Commission, 1926, p. 15. Located at the Iowa Department of Transportation, Ames, Iowa.

contract was awarded to William Henkel[11] and the Concrete Engineering Company.[12] Henkel was to build the cantilever deck girder and the Concrete Engineering Co. was hired to encase the stone abutments. The bridge was completed that same year.[13]

III. DESIGN AND TECHNOLOGY OF THE WINNEBAGO BRIDGE

Two major types of bridges are used extensively in Iowa in the late twentieth century for medium and large spans. These are the continuous steel girder and the precast, prestressed concrete girder. The prestressed girder has come into use since World War II, but the continuous bridge has a long history. The Winnebago River Bridge represents an important step in the emergence of this technology from experimental to common use.

The continuous beam, girder, or truss bridge has the advantage over simply supported structures in a saving of material and greater stiffness.[14] This was demonstrated on a grand scale by Robert Stephenson's Britannia Bridge, completed in 1850.[15] American engineers, however, were slow to adopt the idea of continuity in a bridge, considering it impractical both because of its vulnerability to the effects of any pier settlement and the difficulty of calculating the stresses involved.[16] Some very few examples were built in North America, and the theory found

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[11]The exact amount appropriated for the superstructure of the Winnebago River Bridge is unknown. A combined award of $21,920 was made to William Henkel for three construction projects: the Winnebago cantilever deck girder; a 50-foot pony truss; and a steel stringer structure.

[12]The amount of the award to the Concrete Engineering Company is unknown.

[13]Iowa State Highway Commission, Weekly Letting Report 14:22 (June 1, 1926), p.1; Report of the State Highway Commission, 1926, p. 15.

[14]The principle of continuity is clearly explained in Harry Parker, Simplified Design of Reinforced Concrete (New York: Wiley, 1943), chapter 3, and later editions of the same work.

[15]Charles Singer, et al. A History of Technology, 5 The Late Nineteenth Century (Oxford: Clarendon Press, 1958), pp 504-505.

[16]George A. Hool and W.S. Kinne, Movable and Long-Span Steel Bridges, 2nd ed. (New York: McGraw-Hill, 1943), pp. 199-201.

its way into textbooks, but the attitude of the great majority of engineers was summed up, and fortified, by J.A.L. Waddell (the pontifex maximus of the profession) who concluded "few American engineers will countenance the building of continuous girder bridges."[17] In 1917, the next year, Gustav Lindenthal completed the great Sciotoville, Ohio, continuous truss, and engineers began a slow realization of the practical possibilities in the continuous approach.[18]

In Iowa, as in the profession generally, engineers approached the previously condemned idea with care. In trusses and in girders the nearest thing to a continuous structure is a cantilever. For major bridges, such as crossings of the Mississippi and Missouri rivers, cantilever trusses had been used for decades. The first large continuous truss was the Nebraska City bridge over the Missouri, built in 1929.[19] Others were built in the 1930s over the Mississippi, the Missouri, and the Des Moines rivers.

Of wider importance throughout the state was the gradual acceptance of continuous bridges for moderately large crossings. The first, so far as is known, was designed by the highway commission to replace a Luten patented arch that had collapsed in Ames. Built to carry the Lincoln Highway over Squaw Creek, the bridge was a three-span steel through plate girder, and it was continuous. The inflammatory word "continuous" was not used, however, in describing the bridge. The captions to published photographs merely call attention to the beauty of the "continuous curve" of the camber of the bridge, "instead of a series of lines breaking at the pier points."[20] Also noted is the fact that the three girders are "permanently connected to each other end to end," thus saving in the number of supports needed on the top of the piers.[21] If this seems to press the issue of disguising the new a bit far, it is well to note that when the state highway system was established two years earlier, "so great was the opposition to the word 'state' and a state-controlled

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[17]Bridge Engineering I (New York: Wiley, 1916), p. 482.

[18]Carl W. Condit, American Building Art: The Twentieth Century (New York: Oxford University Press, 1961), pp. 92-100.

[19]Sverdrup & Parcel, Engineering Projects (St. Louis: 1946).

[20]Iowa State Highway Commission, Service Bulletin 9 (March-April, 1921):3.

[21]Ibid., p. 5.

road system, that legislators, fearing for their political futures, names it the 'Primary Road System'."[22]

The cantilever design was also used first with regard to concrete structures. As early as 1905, a concrete cantilevered girder was built for the street railway in Marion.[23] The highway commission experimented with reinforced concrete cantilever girders, beginning with one at Woodbine (also on the Lincoln Highway) in 1917. Others followed, noted in the bridge design section of the commission's Annual Reports.[24] In 1926 the commission reported the design of a "monolithic concrete girder" that "makes use of the cantilever principle."[25] This was the Winnebago River Bridge (HAER No. IA-78) just north of Mason City.

But things began to change more rapidly. Other states were also introducing the continuous bridge.[26] By 1929 an editorial in the Engineering News-Record could proclaim that "structural views have made distinct progress since the days when continuous bridges were considered bad practice."[27] Iowa began to regularly construct continuous bridges, usually of the steel plate girder variety.[28] Those that were built in the 1930s are remarkable

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[22]William Thompson, Transportation in Iowa: A Historical Summary (Ames: Iowa Department of Transportation, 1989), p. 73.

[23]This may have been the first such bridge in the nation. Carl Condit, American Building (Chicago: University of Chicago Press, 1968), p. 257.

[24]Those listed in Fraserdesign, Iowa Historic Bridge Inventory (1993), are Herrold, 1921 (POLK13), Goldfield, 1921-22 (WRIG27), Okoboji, 1929 (DICK01), and Spirit Lake, 1939 (DICK02).

[25]Iowa State Highway Commission, Annual Report for 1926, p. 15.

[26]Oregon State Highway Commission, Eighth Biennial Report...1926...1928 (Salem, Oregon: 1929), p. 71.

[27]Ibid., January, 17, 1929, p. 89.

[28]The conclusion that few concrete continuous bridges were built is tentative. The Iowa Historic Bridge Inventory rarely identifies continuous structures, so it is of little value in checking among the surveyed items for this structural type. From an economic point of view, concrete continuous girders, due to cost of formwork, would usually be more expensive, thus less

examples of innovative design in response to the demands of the age of automobiles and highways.

The Winnebago River Bridge is a reinforced concrete structure, built in 1926. It has three spans, the center of 70′ and each end span of 24′-2 ½". There are four monolithic concrete girders spaced 8′-6" on centers.[29] It is called a cantilever deck girder. Earlier bridges of this type, such as the Woodbine bridge of 1917, were what might be called a normal cantilever, with a middle suspended span held up by two cantilever arms and anchor arms reaching to the abutments on the other side of the piers.[30] The Winnebago cantilever is, in a sense, inverted. That is, the two halves have been turned so that the anchor arms join in the middle (without a suspended span) and the cantilevers reach to the abutments. This description would also fit a continuous bridge with three spans over four supports. The bridge has one fixed and the other movable bearings, another characteristic of continuous bridges. But the proportions of the spans put the bridge in the structural class of cantilever, since the end spans are so short in comparison to the central span. A continuous span would have three spans much closer in length.[31]

Thus the bridge should be classed as a cantilever, but it is very close in its structural action to a continuous bridge.[32] Its reinforcement pattern is similar to a continuous bridge. Despite its massive and rather ungainly appearance, it had impact on continuous bridge design. Recently rehabilitated and kept in service carrying the southbound traffic of U.S. Highway 65, the bridge has proved to be structurally sound.

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common. The concrete bridge really came into its own with the introduction of prestressed beams after World War II.

[29]Design for Cantilever Deck Girder Bridge, Iowa Highway Commission, May 1926, Iowa Department of Transportation, file no. 7121.

[30]Photo postcard of "New Cement Bridge, Woodbine, Ia.", postmarked 1917, in author's (James Hippen) collection.

[31]Marko Salvadori and Robert Heller, Structure in Architecture. The Building of Buildings, 2nd ed. (Englewood Cliffs, New Jersey: Prentice-Hall, 1975), pp. 162-65.

[32]Rowland J. Mainstone, Developments in Structural Form (Cambridge, Mass.: M.I.T. Press, 1975), pp. 240, 247.

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APPENDIX A Bridge Designs for Winnebago River Bridge

A. Design plans located at Cerro Gordo County Engineer's Office, Mason City, Iowa.

1. *Design for Cantilever Deck Girder Bridge 1-70' and 2-26 spans. Concrete Floor, Abutments, and Piers.* IHC. May 1926. Design No. 426. Cerro Gordo Co. Plan B-28-D. [3 sheets]

B. Microfilm files located at the Iowa Department of Transportation, Ames, Iowa. Filed under: File 7121, File 6723, Design 426, and Design 124.

1. *Design for Cantilever Deck Girder Bridge 1-70' and 2-26 spans. Concrete Floor, Abutments, and Piers.* IHC. May 1926. Design No. 426. Job 7121. [3 sheets] -microfilm copies of design plans in Sec. A.1. above.

2. *Situation Plan of Bridge Over Lime Creek.* North of Sugar Plant, Mason City, Iowa. Undated. [1 sheet]

3. Topographic plan showing previous superstructure. Untitled. Undated. [1 sheet]

APPENDIX B List of Illustrations

Fig.1 Profile sketch of the Winnebago River Bridge. James Hippen, 1996.

Fig.2 Detail from bridge design: "Topographic plan showing previous superstructure." Untitled. Undated.

WINNEBAGO RIVER BRIDGE

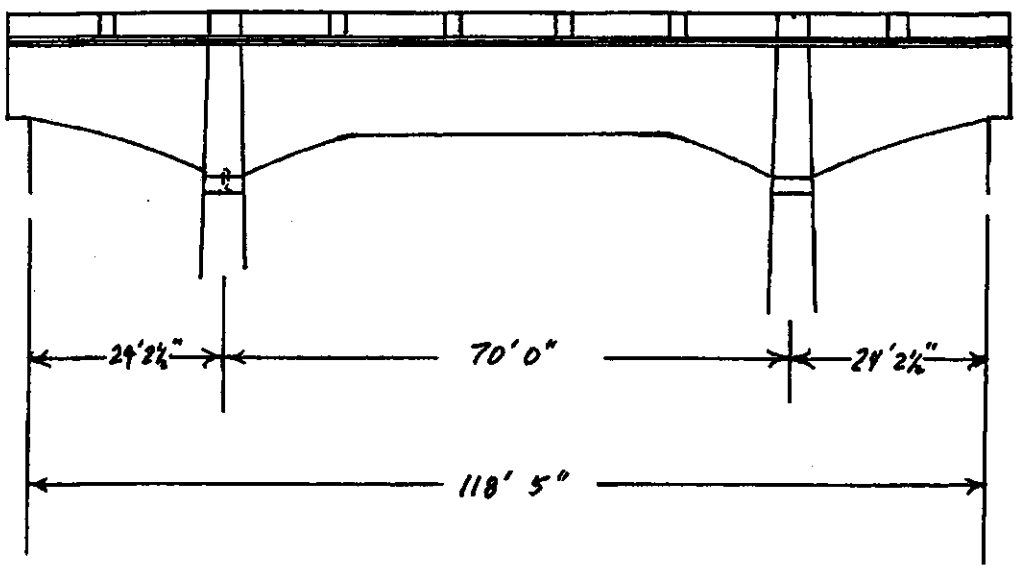

Fig.1 Profile sketch of the Winnebago River Bridge. James Hippen, 1996.

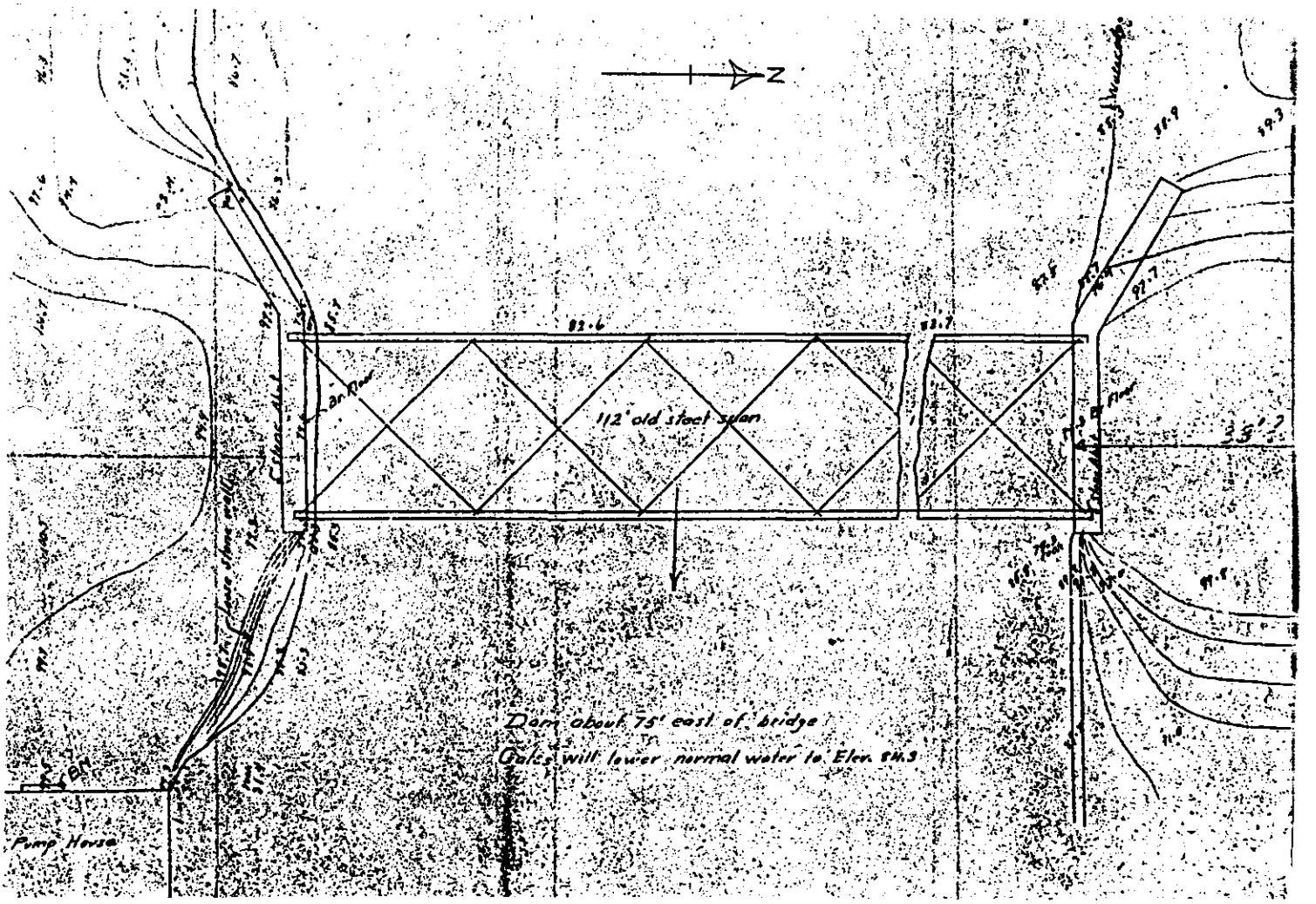

Fig.2 Detail from bridge design: "Topographic plan showing previous superstructure." Untitled. Undated.

APPENDIX C Research Statement

Research Limitations

Bridge designs exist on microfilm only, no originals were discovered. Nor were any historical photos found at IDOT or elsewhere.

Future Directions for Researching the Winnebago River Bridge

Local newspapers and historical societies may have historical materials on the Winnebago River Bridge.

ADDENDUM TO
WINNEBAGO RIVER BRIDGE
Iowa Historic Bridges Recording Project II
Spanning Winnebago River at U.S. Highway 65
Mason City vic.
Cerro Gordo County
Iowa

HAER No. IA-78

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WINNEBAGO RIVER BRIDGE

This appendix is an addendum to a 16-page report previously transmitted to the Library of Congress.

APPENDIX: ADDITIONAL REFERENCES

Interested readers may consult the Historical Overview of Iowa Bridges, HAER No. IA-88: "This historical overview of bridges in Iowa was prepared as part of Iowa Historic Bridges Recording Project - I and II, conducted during the summers of 1995 and 1996 by the Historic American Engineering Record (HAER). The purpose of the overview was to provide a unified historical context for the bridges involved in the recording projects."